

Claims

1. A method of producing a hard metal film by cathode sputtering comprising the steps of:

- a. placing a substrate in an evacuated chamber comprising an atmosphere comprising inert gas and a reactive gas; and
- b. sputtering a metal cathode target

wherein the concentration of reactive gas is sufficiently low that the metal is sputtered in the metallic mode to deposit a metal film.

2. A method according to claim 1, wherein the metal is

selected from the group consisting of titanium, zirconium, tantalum, hafnium, niobium, vanadium and mixtures thereof.

3. A method according to claim 2, wherein the metal is

selected from the group consisting of titanium and zirconium.

4. A method according to claim 3, wherein the metal is titanium.

5. A method according to claim 1, wherein the reactive gas is selected from the group consisting of oxygen and nitrogen.

6. A method according to claim 5, wherein the reactive gas is oxygen.

7. A method according to claim 1, wherein the inert gas is argon.

8. A method according to claim 7, wherein the atmosphere comprises argon and up to 30 percent oxygen.

9. A method according to claim 1, comprising the further step of thermally oxidizing the metal film.

10. A method according to claim 9, comprising the further step of depositing a metal oxide layer over the metal film prior to the step of thermally oxidizing the metal film.

11. A product prepared by the method of claim 1.

12. A product prepared by the method of claim 2, wherein the metal is selected from the group consisting of titanium, zirconium, tantalum, hafnium, niobium, vanadium and mixtures thereof.

13. A product prepared by the method of claim 2, wherein the metal is selected from the group consisting of titanium and zirconium.

14. A product prepared by the method of claim 3, wherein the metal is titanium.

15. A product prepared by the method of claim 1, wherein the reactive gas is selected from the group consisting of oxygen and nitrogen.

16. A product prepared by the method of claim 5, wherein the reactive gas is oxygen.

17. A product prepared by the method of claim 1, wherein
the inert gas is argon.

18. A product prepared by the method of claim 7, wherein
the atmosphere comprises argon and up to 30 percent oxygen.

19. A product prepared by the method of claim 1, wherein
the metal film is thermally oxidized.

20. A product prepared by the method of claim 9, further
comprising a metal oxide film deposited on the metal film prior to
thermal oxidation of the metal film.